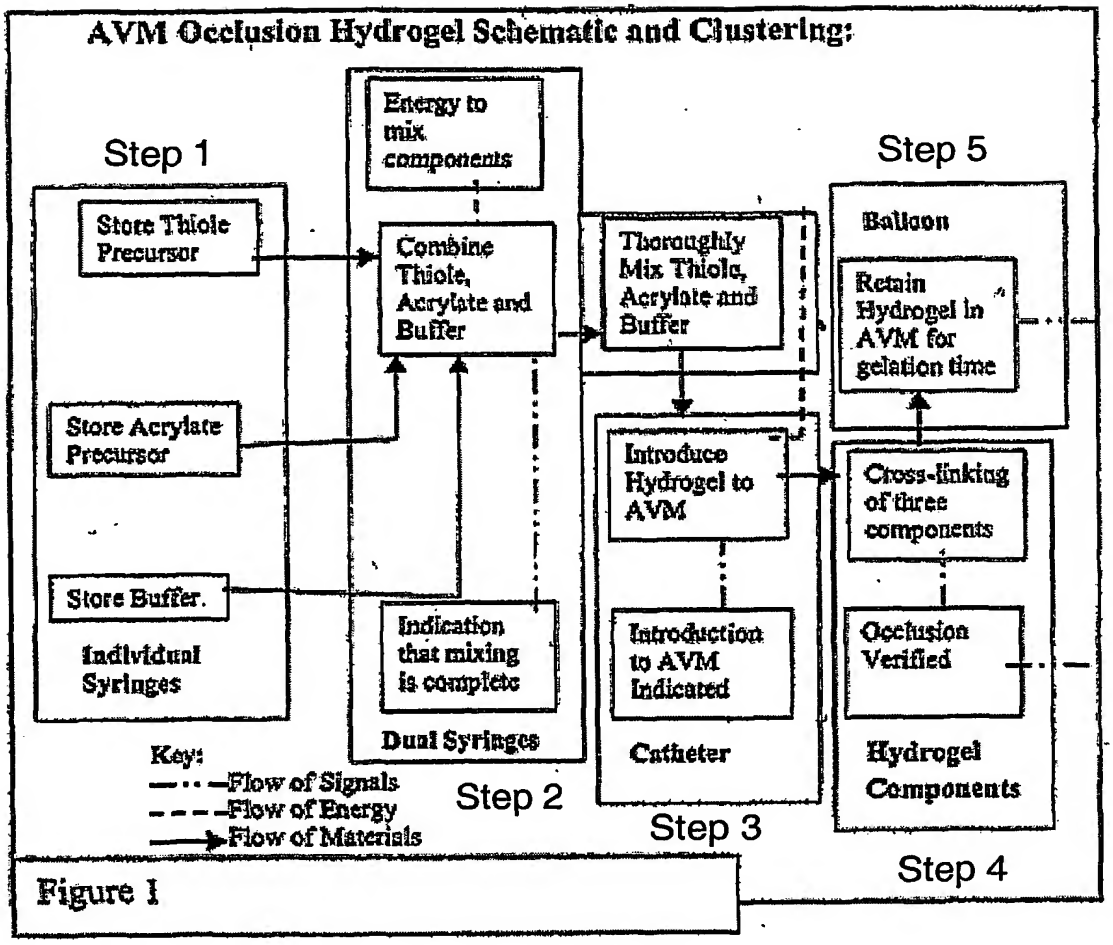

AVM Occlusion Hydrogel Schematic and Clustering:
Step 1
Store Thiole Precursor
Store Acrylate Precursor
Store Buffer.
Individual Syringes
Energy to mix components
Combine Thiole, Acrylate and Buffer
Indication that mixing is complete
Dual Syringes
Step 2
Thoroughly Mix Thiole, Acrylate and Buffer
Introduce Hydrogel to AVM
Introduction to AVM Indicated
Catheter
Step 3
Balloon
Retain Hydrogel in AVM for gelation time
Cross-linking of three components
Occlusion Verified
Hydrogel Components
Step 4
Step 5
Key:
Flow of Signals
Flow of Energy
Flow of Materials

Figure 1

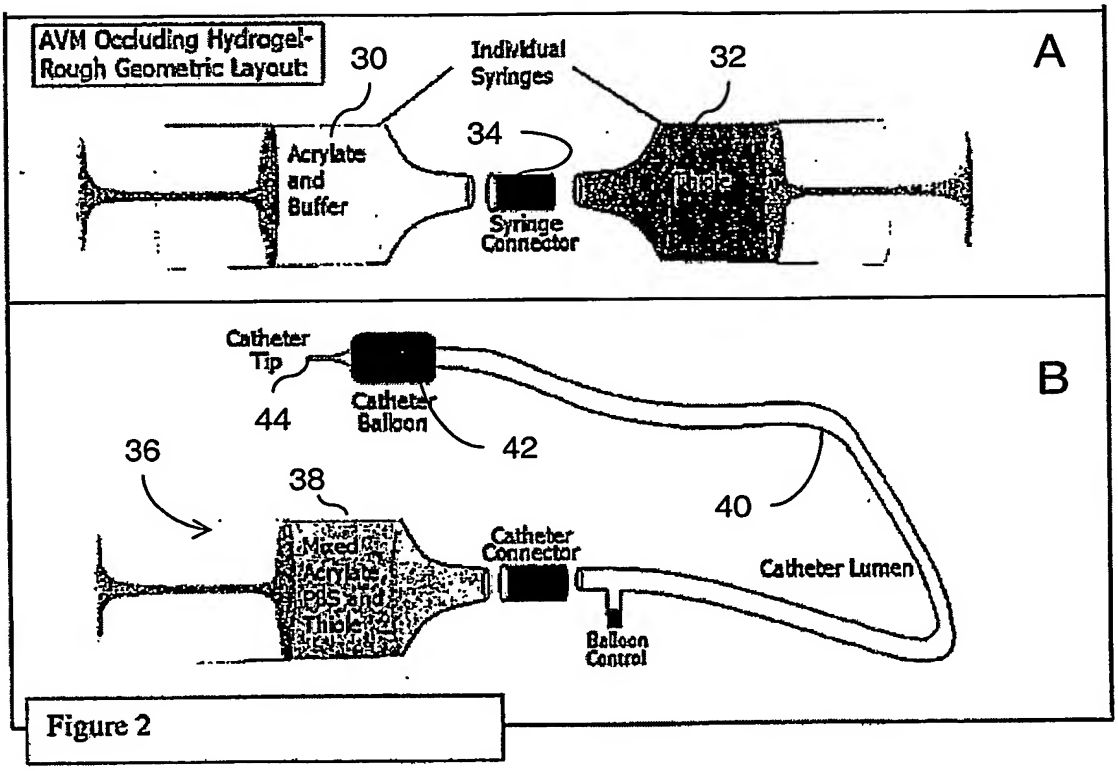

AVM Occluding Hydrogel-
Rough Geometric Layout:
30
Individual
Syringes
32
A
34
Acrylate
and
Buffer
Syringe
Connector
Catheter
Tip
44
Catheter
Balloon
42
B
36
38
40
Mixed
Acrylate,
PBS and
Thiole
Catheter
Connector
Catheter Lumen
Balloon
Control

Figure 2

Figure 3

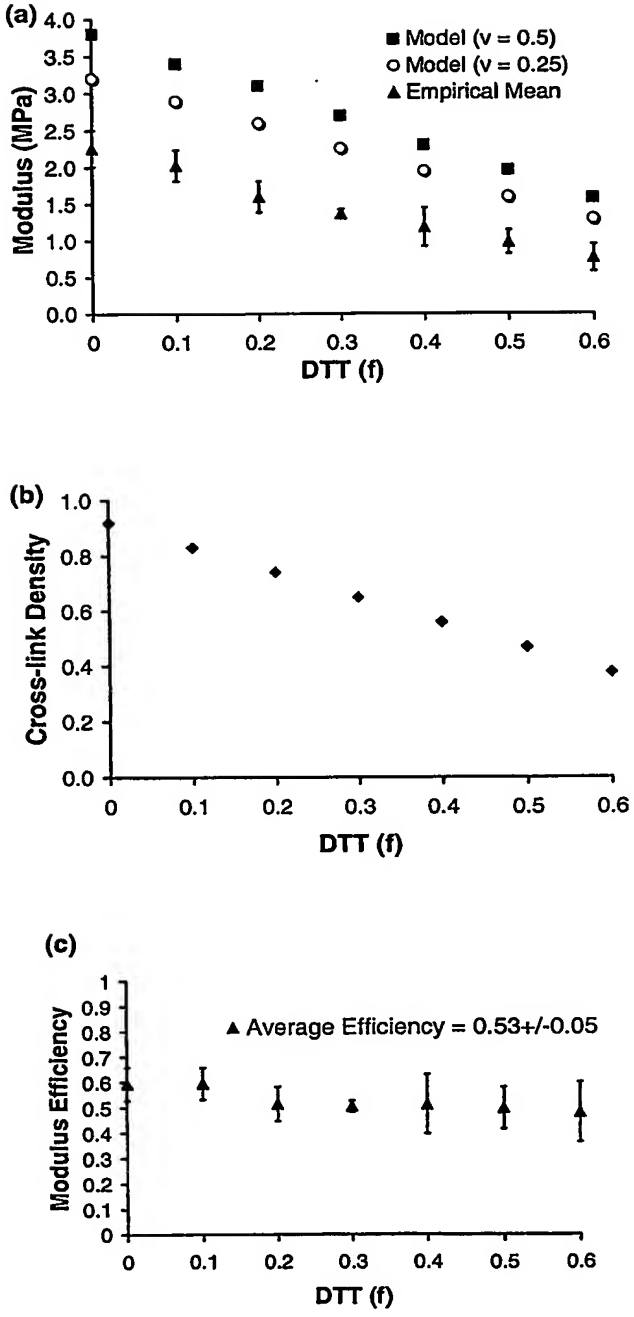

(a)
Modulus (MPa)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
0.1
0.2
0.3
0.4
0.5
0.6
DTT (f)
Model (v = 0.5)
Model (v = 0.25)
Empirical Mean
(b)
Cross-link Density
1.0
0.8
0.6
0.4
0.2
0.0
0
0.1
0.2
0.3
0.4
0.5
0.6
DTT (f)
(c)
Modulus Efficiency
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
DTT (f)
Average Efficiency = 0.53+/-0.05

Figure 4

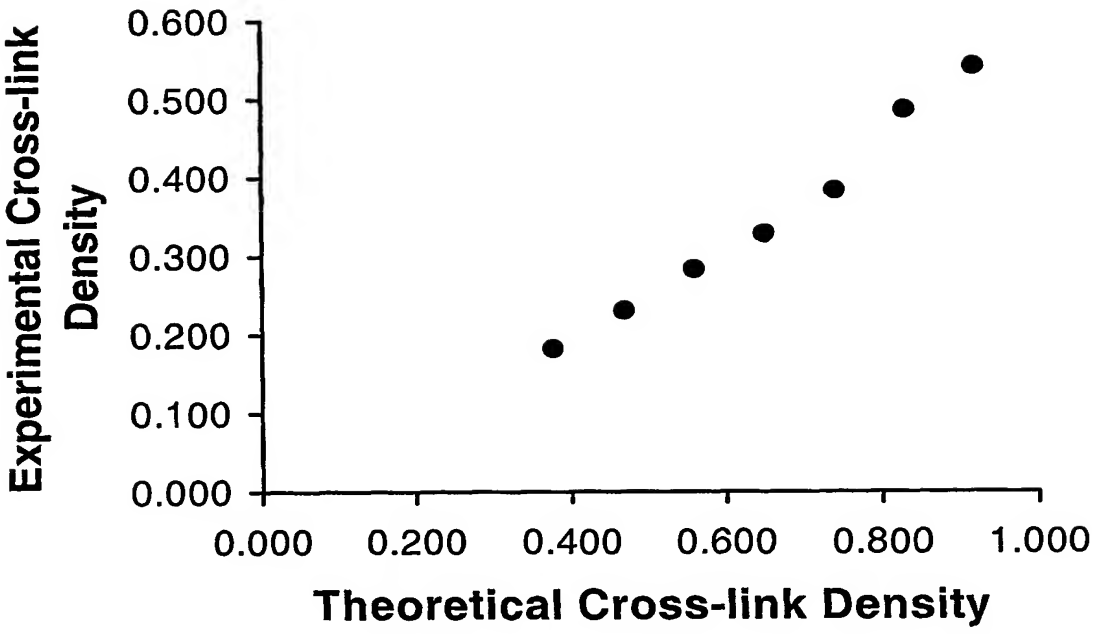

Experimental Cross-link Density
0.600
0.500
0.400
0.300
0.200
0.100
0.000
0.000
0.200
0.400
0.600
0.800
1.000
Theoretical Cross-link Density

Figure 5

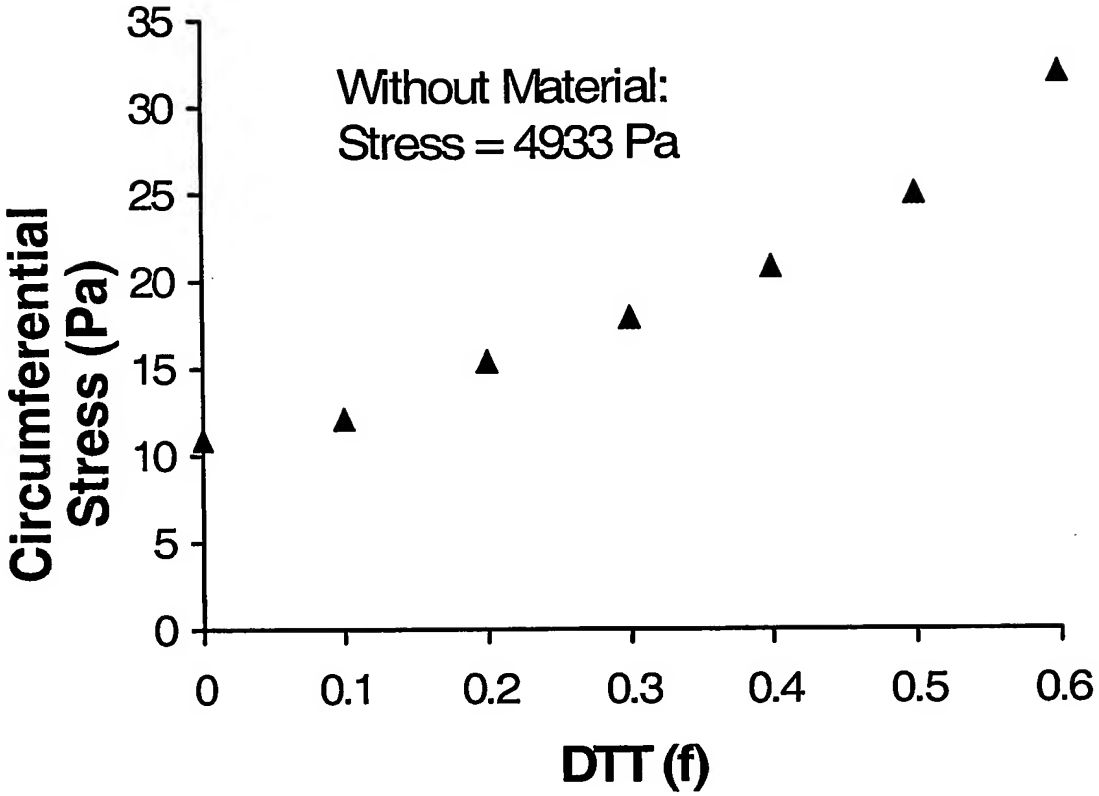
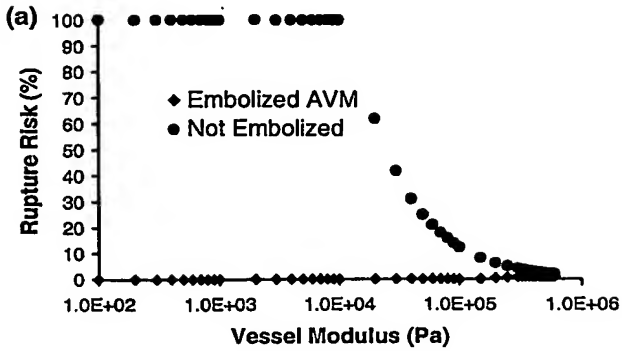
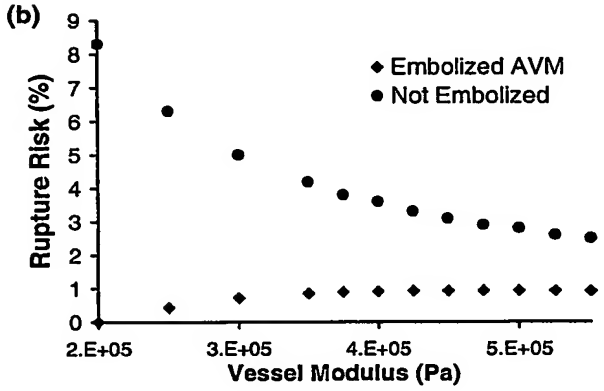

Without Material:
Stress = 4933 Pa
Circumferential Stress (Pa)
35
30
25
20
15
10
5
0
0
0.1
0.2
0.3
0.4
0.5
0.6
DTT (f)

Figure 6


(a)
Rupture Risk (%)
100
90
80
70
60
50
40
30
20
10
0
Embolized AVM
Not Embolized
1.0E+02
1.0E+03
1.0E+04
1.0E+05
1.0E+06
Vessel Modulus (Pa)


(b)
Rupture Risk (%)
9
8
7
6
5
4
3
2
1
0
Embolized AVM
Not Embolized
2.E+05
3.E+05
4.E+05
5.E+05
Vessel Modulus (Pa)

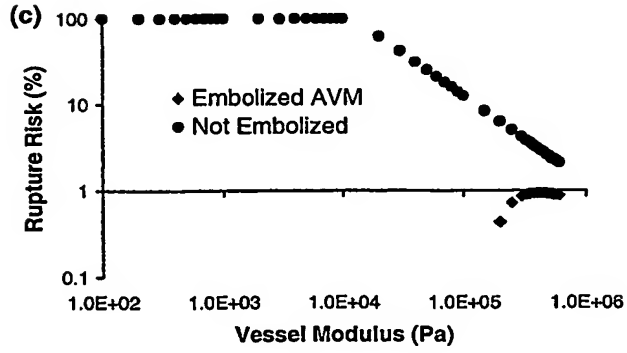

(c)
Rupture Risk (%)
100
10
1
0.1
Embolized AVM
Not Embolized
1.0E+02
1.0E+03
1.0E+04
1.0E+05
1.0E+06
Vessel Modulus (Pa)

Figure 7

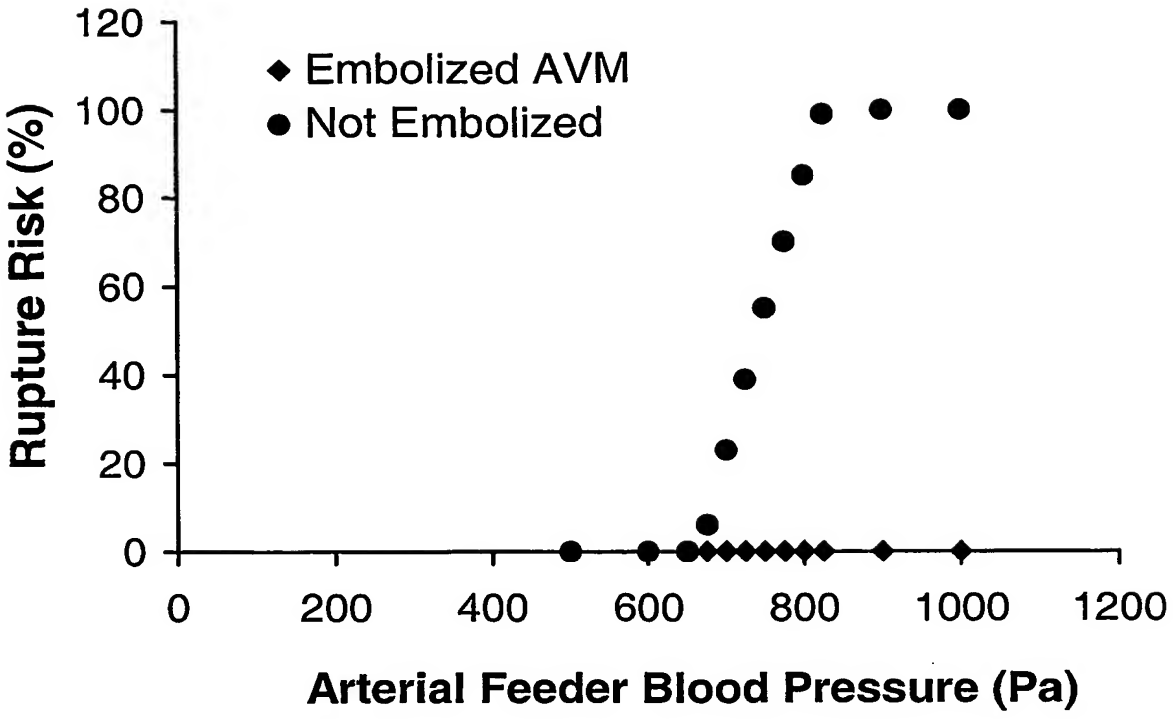

120
100
80
60
40
20
0
Rupture Risk (%)
◆ Embolized AVM
● Not Embolized
0
200
400
600
800
1000
1200
Arterial Feeder Blood Pressure (Pa)

Figure 8

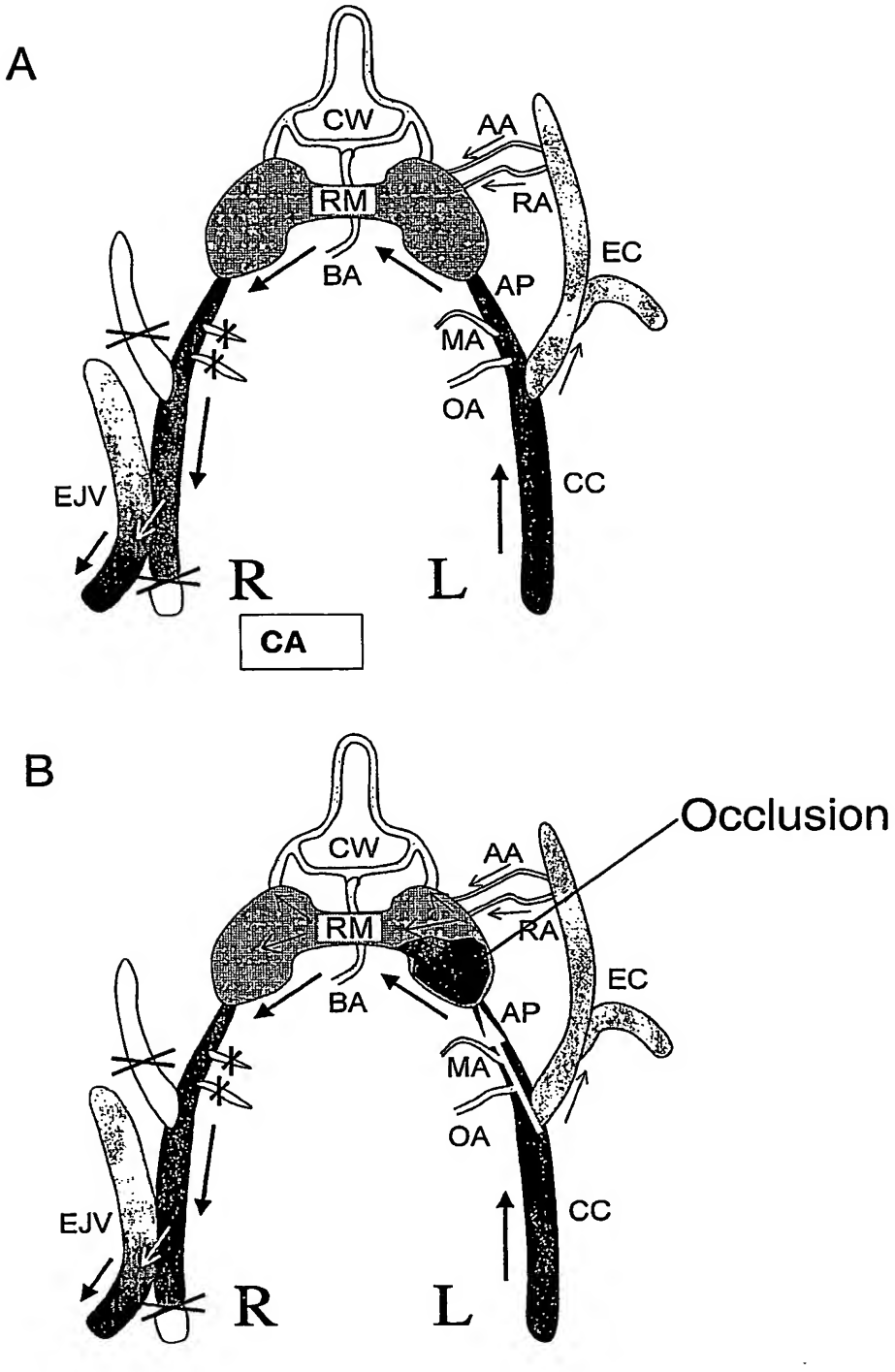
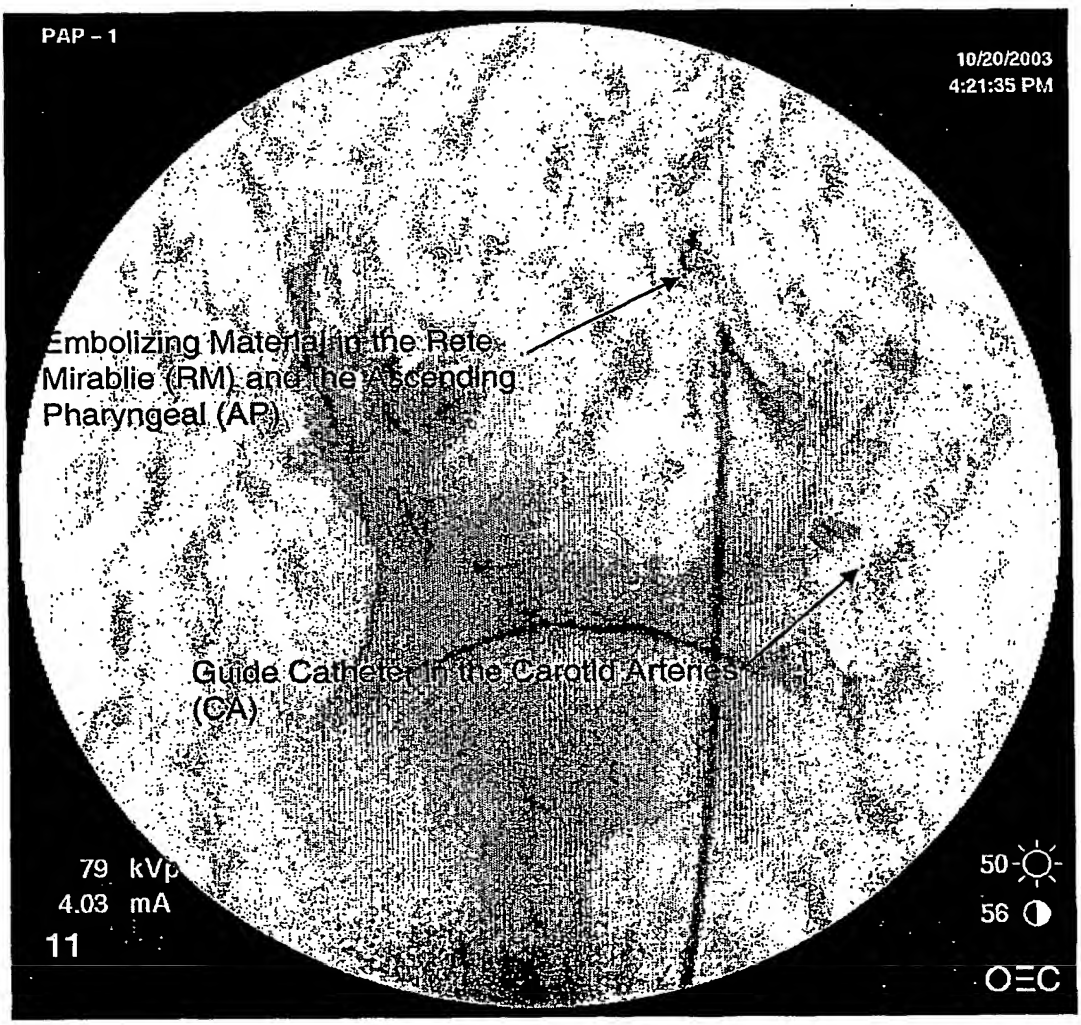

A
CW
AA
RM
RA
EC
BA
AP
MA
OA
EJV
CC
R
L
CA
B
Occlusion
CW
AA
RM
RA
EC
BA
AP
MA
OA
EJV
CC
R
L

Figure 9


PAP - 1
10/20/2003
4:21:35 PM
Embolizing Material in the Rete Mirablie (RM) and the Ascending Pharyngeal (AP)
Guide Catheter in the Carotid Arteries (CA)
79 kVp
4.03 mA
11
50
56
OEC